Published in final edited form as:

. 2011 October ; 161(1): 105–115. doi:10.1635/053.161.0108.

A new species of *Lienardia* (Gastropoda: Conoidea) from the Philippines and the Spratly Islands

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Abstract

A new species of *Lienardia* (Conoidea: Clathurellidae) is described from the Philippines and Spratly Islands and compared to *L. giliberti* Soubervie, 1874, with which it has been confused. The species is routinely found in lumun-lumun nets in the southern Philippines, particularly in the Panglao area, in depths of 50 and 110 m. Correlations between radular morphology and shell coloration support maintaining *Lienardia* and *Clathurella* as distinct genera.

Introduction

The new species described here was probably first collected 30 or more years ago: F. J. Springsteen sent a specimen to ANSP that was catalogued in December 1982. Springsteen and Leobrera (1986) illustrated this species as *Lienardia* (*Lienardia*) sp. In November 1986, Springsteen sent more specimens to V. O. Maes at ANSP for identification, but Maes had passed away the month before. In 1988 one of us (GR) helped sort material in Maes's former office, and in following up on Springsteen's request for identifications advised him that the species was similar to *Lienardia giliberti*, and identified specimens as such in the ANSP collection.

Springsteen's labels stated the specimens were from "shell grit" or "shell drift" from deep water in the Philippines. By this he meant material collected in lumun-lumun nets, bundles of old fishing nets left on the bottom for several months to be colonized by planktonic molluscan larvae (Seroney et al. 2010). The species is still collected that way, and has been encountered during quantitative sampling by the NIH-funded PMS-ICBG (www.pms-icbg.org). Further research showed that it was not *L. giliberti*, but an unnamed species, which is described herein.

Methods

Measurements and counts were made with a Wild M5 dissecting microscope equipped with an ocular micrometer, except for paratypes 16, 17, 19 and 20. Measurements have an error of 0.1 mm. Whorls were counted as the number of times the suture passed a line drawn perpendicular to its origin, and have an error of 0.1 whorls. In the description, "ribs" means "axial ribs" (raised sculptural elements parallel to the shell axis), and "cords" means "spiral cords" (raised sculptural elements transverse to the axis). ESEM scans were made with a Fei Quanto 250 electron microscope. The turrid material of the Panglao Marine Biodiversity

Project 2004 (Bouchet et al. 2009b) was segregated to “morphospecies” by one of us (PS). Abbreviations are as follows:

ANSP	Academy of Natural Sciences, Philadelphia, PA, USA
ESEM	Environmental scanning electron microscope
GPS	Geographical Positioning System, indicates that stated coordinates were recorded at the site by a hand-held unit
MHNB	Muséum d’Histoire naturelle de Bordeaux, France
MNHN	Muséum national d’Histoire naturelle, Paris, France
PBRC	Philippine Biodiversity Resource Center, University of the Philippines, Diliman
PMS-ICBG	Philippine Mollusk Symbiont International Cooperative Biodiversity Group
PSC	Peter Stahlschmidt collection, Germany
SL	Shell length
SMF	Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany
ZMMU	Zoological Museum, Moscow University, Russia

Systematics

Family Clathurellidae H. & A. Adams, 1858

Genus *Lienardia* Jousseaume, 1884

Type species, *Clavatula rubida* Hinds, 1843 (original designation)

Lienardia totopotens new species

(Figs. 1–6, 7–12, 13–18, 19–20)

Lienardia (*Lienardia*) sp. Springsteen & Leobrera 1986: 276, fig. 5

Lienardia undescribed. Poppe 2008: 13, top, second from left

Clathurella species 4. Seronay et al. 2010: 6, fig. 5, middle, second from right

Lienardia sp. Fedosov 2011: 134, fig. 6L, M, 7C

Description—Shell to 12.5 mm, fusiform, with acute spire, dominant color pink. Protoconch paucispiral, pink, of 1.8–2.0 whorls, covered by a microsculpture of tiny and weak granules (Fig. 19), with peripheral keel on last half whorl, sometimes second keel visible just above suture, junction with teleoconch sigmoidal. Teleoconch of 5–7 rounded whorls, sculptured with 7–9 strong axial ribs, and 3–4 spiral cords. Axial ribs increase to 10–12 by body whorl; spiral cords increase to 7–10 by penultimate whorl with 20–25 on

body whorl (not counting occasional faint secondary cords intercalated between stronger cords). Cords closer together and weaker on sutural ramp than on rest of whorl. Early spire whorls pink, with cords near periphery becoming brown in second or third whorl, and periphery of whorl becoming paler by third or fourth whorl, pale area becomes off-white stripe at or just below periphery on lower spire and body whorl. Stripe generally bordered by two brown cords with third in center, pale area extends beyond stripe on axial ribs; intercostal spaces above stripe often somewhat browner, cords often darker where crossing intercostal spaces and lighter where crossing ribs; 2–3 pink cords above brown ones, near suture. Cords on body whorl brown posteriorly, fading to pink by mid-aperture, columellar side. Exterior of outer lip scalloped (e.g., Figs. 2, 11). Aperture less than half shell length, interior smooth and pink with external color banding visible in transparency, u-shaped turrid notch at suture, heavy varix behind outer lip, with 5–7 denticles inside outer lip; siphonal canal short, open; columellar area of inner lip with 4–8 denticles. Microsculpture of tiny granules (about 0.02 – 0.03 mm), covers exterior of teleoconch except for spiral cords, sometimes distributed randomly and sometimes aligned diagonally for short distances (Fig. 20).

Type locality—Balicasag Island, Panglao Municipality, Bohol Province, Philippines, 09.5202°N, 123.6829°E (GPS), 40–50 m (R. Seronay, email to GR, 3 May 2011). A map of the type locality is shown in Seronay et al. (2010, fig. 1), but the collecting site is erroneously shown on the west side of Balicasag, rather than the north side, and the depth is given as 30–40 m. The raising of the nets containing the specimen that became the holotype was video-taped; a frame from the tape is shown in Seronay et al. (2010). One of us (GR) was present when the net containing paratype 3 was raised, essentially at the type locality, with GPS coordinates differing by only 35 m from those of the holotype (measured in Google Earth).

Type material—Counts and measurements are given in Table 1.

Philippines: Holotype: PBRC 10101, collected 9 January 2009, SL 9.0 mm (Figs. 1–3); this is the specimen illustrated by Seronay et al. 2010: 6, fig. 5. Paratypes 1–2: PBRC 10102 and 10103, Balicasag, 09.52031°N, 123.68287°E (GPS), 54 m, 7 September 2009, SL 7.7 mm (Figs. 16–18) and 8.5 mm; Paratype 3: PMS-1050P (PMS-ICBG voucher for microbiology, to be deposited in PBRC), Balicasag, 09.52051°N, 123.68282°E (GPS), 40–50 m, 4 May 2010, SL 7.8 mm (juvenile); Paratype 4: ANSP 355856, “Punta Engano”, SL 12.0 mm (Figs. 4–6); Paratypes 5–7: ANSP 423550, “Punta Engano”, 1984, SL 11.0 (Figs. 13–15), 9.2 (Figs. 7–9) and 8.6 mm (Figs. 10–12); Paratypes 8–10: ANSP 423551, “Punta Engano”, SL 9.0, 10.0 and 10.2 mm; Paratype 11–13: MNHN 23301, Balicasag, 9°30.9′N, 123°41.2′E, 90–110 m (lumun-lumun, Panglao Marine Biodiversity Project 2004, Sta. L46), SL 7.7 (Figs. 19–20), 10.6 and 9.5 mm; Paratype 14: SMF 336408, Balicasag, 60–100 m (lumun-lumun), SL 8.6 mm; Paratype 15: ZMMU Lc-39481, Balicasag (lumun-lumun), SL 8.5 mm; Paratypes 16–17: PSC 020160, Balicasag, 60–100 m (lumun-lumun), SL 10.6 and 12.5 mm.

Spratly Islands (South China Sea), Louisa Reef, in grit from ledges along wall, 55–65 m (leg. Felix Lorenz, scuba dive, 2006): Paratype 18: ANSP 426227, SL 9.1 mm and Paratypes 19–20: PSC 020161, SL 9.1 and 11.0 mm.

Other material examined—Spratly Islands, one juvenile specimen lacking the protoconch, from the same location as paratypes 18–20.

Distribution and Habitat—Known only from the southern Philippines and Spratly Islands (South China Sea). Reliable records from the Philippines were all taken by lumun-

lumun nets at Balicasag (Bohol) with depths records from 50–110 m. Sheila Tagaro (email to GR, 25 March 2011) states that the species is also fished at Aliguay, Surigao, and Butuan (Mindanao). ANSP 355856, 423550 and 423551 have original labels from F. J. Springsteen stating that they come from Punta Engano, Mactan Island, Cebu in “shell drift” or “shell grit” from deep water. However, Baldomero Olivera states that although the species is commonly found in lumun-lumun nets at Balicasag, he has never seen it from nets at Punta Engano (pers. comm. to GR, 19 March 2011), perhaps because nets there are not placed as deep as at Balicasag. Springsteen’s material was likely purchased in Punta Engano, which is a distribution center for shells in the Philippines, but presumably came from a locality farther south.

Just before this article went to press, we saw an online illustration of a 10 mm specimen from Reunion that may be conspecific with *Lienardia totopotens*. It was listed as “*Lienardia* sp. Coll. Drivas 2” at <http://vieocean.free.fr/mollusques/mangeliidae3.htm>, with the description, “Téloconque haute et turriculée de 6 tours convexes. Côtes axiales arrondies, 12 par tour, surcroisées par de fines cordes spirales espacées, 5 sur les tours, 17 sur le corps et la base. Ouverture comprimée à sinus profond. Rose avec une bande spirale blanche au milieu des tours, les cordes spirales plus foncées, 3 d’entre elles franchement brunes sur la bande blanche. Un seul spmn dans le sable dragué de 50 m.” This description, and the depth, are consistent with our new species, but we were unable to borrow the specimen in time to confirm the identification and what would be a significant range extension.

Etymology—Named for Dr. Baldomero “Toto” Olivera, distinguished professor of Biology at The University of Utah, who recruited and inspired the interdisciplinary collaborators of the PMS-ICBG project; from English “totipotent”: having unlimited capabilities; having the ability to differentiate into all cell types. Olivera’s research group is currently exploring toxins produced by this species.

Discussion

The intensive exploration of the Panglao region (including Balicasag) of Bohol in the course of the Panglao Marine Biodiversity Project in 2004 (Bouchet et al. 2009b), and other intensive collecting in the Philippines has not revealed any specimens of this species taken dead or alive by methods other than lumun-lumun. However, Felix Lorenz found 4 fresh specimens in grit from ledges along a wall at 55–65 m at the Spratly Islands (South China Sea). Almost all dives of the Panglao expedition were performed shallower than 30 m (Bouchet et al. 2009b), the habitat of *Lienardia totopotens* may be restricted to deep reefs of the so called ‘twilight zone’ which are too deep to sample by conventional diving and too close to shallower reefs for navigation and safe dredging (Pyle 1996; Bouchet et al. 2009a). *Lienardia totopotens* has a protoconch indicative of planktonic, non-planktotrophic, larval development, so it would not be surprising if it proved to be more broadly distributed than reported here, especially considering our limited knowledge of the fauna of deep reefs.

Lumun-lumun nets have been assumed to be colonized primarily by settlement of larva rather than by organisms living in and on surrounding substrates. Seronay et al. (2010: 1258) noted “bundled nets are generally set where there are currents rich in molluscan larvae... fishermen have considerable empirical experience in which specific spots yield a productive lumun-lumun catch”. Preliminary data from PMS-ICBG sampling corroborates this assumption: many species found in lumun-lumun nets are not found in benthic samples collected adjacent to them, and vice-versa. The net from which the holotype of *Lienardia totopotens* was collected was placed on the bottom in July 2008 and raised on 9 January 2009. Assuming the holotype-to-be colonized the net as a veliger, members of the species can be inferred to reach maturity in 6 months or less.

As shown in the chresonymy, Springsteen and Leobrera (1986) were the first to illustrate this species, considering it an undescribed *Lienardia*. Poppe (2008) and Seronay et al. (2010) also illustrated it as undescribed. The species occasionally has been illustrated online and has been sold by dealers, either as *L. giliberti* or an unidentified *Lienardia*. Among described species of Conoidea, *L. totopotens* is indeed most similar to *L. giliberti* (Souverbie in Souverbie & Montrouzier, 1874). Souverbie's taxon was named from a unique specimen from Lifou, Loyalty Islands, New Caledonia. The holotype is in the Bordeaux Museum (Figures 21–22). Topotypical material from the ANSP collection (Figures 23–26) is consistent with the holotype and the original description, as are illustrations of *L. giliberti* published by Hasegawa et al. (2000: 648, fig. 142) and Chang (2002: 116, fig. 13-1). (Hasegawa et al. and Chang both misspelled the name as “gilberti”).

Lienardia giliberti differs from *L. totopotens* in a number of characteristics. It has 2.5 or more protoconch whorls, versus 2.0 or fewer in *L. totopotens*; the axial ribs are similar in width to their interspaces rather than narrower than the interspaces; the siphonal canal is shorter and wider; the colored stripe is lower on the whorl, so that it is mostly hidden on the spire, and it is darker rather than lighter than the surrounding shell. Both species have brown spiral cords, but those in *L. giliberti* are around and below the stripe but not above it. *Lienardia giliberti* has a brown subsutural band (wider than a single cord) that is lacking in *L. totopotens*. The radular teeth in *L. giliberti* have multiple barbs along one side of the shaft, and one apical barb on the other side (Fedosov 2011, fig. 6N), whereas that of *L. totopotens* lacks barbs, but has a single projection below the distal opening of the tooth canal (Fedosov 2011, figs. 6L–M, as *Lienardia* sp.).

Seronay et al. (2010, caption to fig. 5) treated *Lienardia* Jousseaume, 1884 as a synonym of *Clathurella* Carpenter, 1857, without further explanation. Some species of *Lienardia* are quite similar in shell morphology to the type species of *Clathurella*, *Clavatulula rava* Hinds, 1843, from the Eastern Pacific, e.g., *Lienardia cincta* (Dunker, 1871), so it is possible that this synonymy is correct. Fedosov (2011) also noted the similarity of *Clathurella* and *Lienardia*, but maintained them as distinct. His radular data show an interesting correlation of radular morphology and shell coloration. The species having a projection below the distal opening of the tooth canal (marked by arrows in Fedosov's fig. 6) all have a pink protoconch and color pattern including pink, rose or red (*Lienardia* sp., i.e., [*L. totopotens*], *L. cf. L. rosella* Hedley, 1922, *L. roseangulata* Fedosov, 2011 and *L. tagaroe* Fedosov, 2011); to these can be added *Lienardia jousseaumei* (Hervier, 1896) (radula in Bouchet et al. 2011, fig. 5C, is similar to that of *L. tagaroe*). The species with dark protoconch and color pattern in tan, brown and olive lack this projection (*L. acrolineata* and *L. grandiradula*); to these can be added *Lienardia nigrocincta* (Montrouzier in Souverbie & Montrouzier, 1872)¹ (radula in Bouchet et al. 2011, fig. 5B). The type species of *Clathurella* falls in the latter group, whereas the type species of *Lienardia*, *Clavatulula rubida* Hinds, 1843, falls in the pink shell/pink protoconch group. Neither type species has had anatomical or genetic study, but on the basis of the above correlations, *Lienardia* and *Clathurella* are maintained as distinct genera.

The supraspecific classification of *Lienardia* is uncertain. In Powell's (1966) classification of Turridae, *Lienardia* was placed in Mangeliinae. Taylor et al. (1993) also placed *Lienardia* in Mangeliinae, but transferred that and some other turrid subfamilies to Conidae. Rosenberg (1998) showed that the analysis performed by Taylor et al. (1993) did not have sufficient resolution to support their proposed classification and advocated retaining the traditional split between Turridae and Conidae until a more robust phylogenetic result was available. In a molecular phylogeny of Conoidea, Puillandre et al. (2008), found that

¹Spelled both *nigrocincta* and *nigrotincta* in Souverbie & Montrouzier (1872: 362), *nigrocincta* is correct by first reviser's choice of Souverbie & Montrouzier (1873: 56).

Turridae was not monophyletic, and supported the transfer of Raphitominae, Mangeliinae and Clathurellinae to Conidae as suggested by Taylor et al. (1993). Puillandre et al. (2008) did not introduce a revised classification as the node support was not strong enough and taxon sampling not complete enough. Puillandre et al. (2008: 1129) treated *Lienardia* as clathurelline rather than mangeliine, but in their analysis species classified as Clathurellinae were not monophyletic, although all of the clathurelline groups were more closely related to Conidae sensu stricto than to Turridae sensu stricto.

Puillandre et al. (2011) did an expanded molecular analysis that Bouchet et al. (2011) used to revise the classification of the Conoidea. In this classification, Clathurellidae is recognized as a distinct family on the basis of high bootstrap support for the clade, even though its position in the tree was unresolved (an unsupported polytomy with Conidae and Borsoniidae). Puillandre et al. (2011) used *Clathurella nigrocincta* (as “*nigrotincta*”) to represent *Clathurella*, but Bouchet et al. (2011) place this species in *Lienardia* without comment. Based on the correlations of radula and shell coloration noted above, this species may prove to be properly classified as a *Clathurella*.

Tucker & Tenorio (2009) treated Conoidea and Turroidea as distinct superfamilies, which is a reasonable approach given the diversity of the toxoglossans. This division is supported by the tree of Puillandre et al. (2011), but Bouchet et al. (2011) do not discuss the possibility of recognizing two superfamilies. Conoidea would include Conidae, Conorbidae, Borsoniidae, Clathurellidae, Mitromorphidae, Mangeliidae and Raphitomidae, and Turroidea would include Turridae, Cochlespiridae, Drilliidae, Pseudomelatomidae, Strictispiridae, Clavatulidae, Horaiclavidae and Terebridae. Although the position of Clathurellidae is unresolved in the Puillandre et al. tree, it is the oldest name among the taxa that it might ultimately prove to group with: Clathurellidae H. & A. Adams, 1858 versus Borsoniidae Bellardi, 1875, Raphitomidae Bellardi, 1875, Conorbidae de Gregorio, 1880, Mangeliidae Fischer, 1883, and Mitromorphidae Casey, 1904 (see Bouchet & Rocroi 2005: 256; Bouchet et al. 2011: 308). Therefore, if *Clathurella* is not placed in Conidae, it must be a member of Clathurellidae whatever the taxonomic arrangement, because of the rule of priority. If the close relationship of *Lienardia* with *Clathurella* is correct, *Lienardia* must also be a member of Clathurellidae.

This line of reasoning applies only to *Lienardia* sensu stricto. Puillandre et al. (2008) noted that *Lienardia* display several types of protoconchs and was probably polyphyletic. Presumably they meant that some of the subgenera of *Lienardia* in Powell's (1966) classification (*Acrista*, *Hemilienardia* and *Thetidos*) are not closely related to *Lienardia*. The molecular analysis of Puillandre et al. (2011) showed that *Hemilienardia* belongs in Raphitomidae. Bouchet et al. (2011) treated *Acrista* as a full genus within Clathurellidae and, in the absence of new information, retained *Thetidos* as a subgenus of *Lienardia*. Further research is needed to more rigorously define the constituent taxa of Clathurellidae.

Acknowledgments

This research was supported in part by NIH grant IU01TW008163-01, Philippines Mollusk Symbiont International Cooperative Biodiversity Group (PI Margo Haygood, Oregon Health Sciences University). Amanda Lawless (ANSP) helped with an initial draft of the manuscript, and Paul Callomon (ANSP), Alexander Sysoev (ZMMU), and John K. Tucker (Illinois Natural History Survey) provided helpful comments. Alexander E. Fedosov (A. N. Severtzov Institute of Ecology and Evolution, Moscow) graciously allowed us to proceed with the description of this species when we realized that we were working on the same taxon. Romell Seronay (Marine Science Institute, University of Philippines) arranged for loan of material from PBRC. Baldomero Olivera (University of Utah) and Sheila Tagaro (Conchology Inc.) advised on the distribution of the species. We are also grateful to Laurent Charles (Bordeaux Museum) for providing type photos of *Lienardia gilberti*, Heiko Hentrich (University of Koblenz-Landau) for helping with the ESEM, and Felix Lorenz (Germany) for providing interesting turrid material that he collected during deep dives at the Spratly Islands.

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Figures 1–6.

Lienardia totopotens n. sp. 1–3) Holotype, PBRC 10101, SL 9.0 mm. 4–6) Paratype 4, ANSP 355856, SL 12 mm.

Figures 7–12.

Lienardia totopotens n. sp., ANSP 423550. 7–9) Paratype 6, SL 9.2 mm. 10–12) Paratype 7, SL 8.6 mm.

Figures 13–18.

Lienardia totopotens n. sp. 13–15) Paratype 5, ANSP 423550, SL 11.0 mm. 16–18) Paratype 1, PBRC 10102, SL 7.7 mm.

Figures 19–20.
Lienardia totopotens n. sp., MNHN 23301, Paratype 11. 19) ESEM of protoconch. 20) ESEM of microsculpture

Figures 21–26.

Lienardia giliberti (Souverbie, 1874). 21–22) Holotype, MHNB 2004.TY.32, SL 9.1 mm. 23–26) ANSP 99304, Lifou, Loyalty Islands, New Caledonia, SL 8.9 mm (figs. 21) and 7.2 mm (figs. 22–24).

Table 1

Measurements and counts of features of *Lienardia totopotens* and *L. giliberti*.

Species	Lienardia totopotens																			L. giliberti				
Catalogue number	PBRC 10101	PBRC 10102	PBRC 10103	PMS 1050P	ANSP 355856	ANSP 423550			ANSP 423551			MNHN 23301		SMF 336408	ZMMU Lc-39481	PSC 020160	ANSP 426227	PSC 020161	ANSP 99304					
Length (mm)	9.0	7.7	8.5	7.8	12.0	11.0	9.2	8.6	9.0	10.0	10.2	7.7	10.6	9.5	8.6	8.5	12.5	10.6	9.1	11.0	9.1	>8.9	7.3	7.2
Width (mm)	3.7	3.4	3.7	3.3	4.9	4.9	3.9	3.8	3.8	4.3	4.2	3.4	4.6	4.1	3.6	3.7	5.1	4.7	4.1	4.6	3.7	3.8	3.2	3.0
Depth (mm)	3.3	3.2	3.3	3.3	4.3	4.2	3.4	3.3	3.5	3.7	3.9	3.0	4.2	3.6	3.2	3.3	4.3	3.9	3.6	3.8	2.9	3.4	3.0	2.6
Aperture height (mm)	4.4	4.0	4.4	3.7	5.8	5.6	4.5	4.5	4.6	5.0	5.2	4.1	5.7	5.0	4.3	4.5	6.1	5.0	4.9	5.4	4.2	4.7	2.9	3.5
Teleoconch whorls	6.0	5.3	5.7	5.2	7.0	6.5	6.3	6.0	6.1	6.6	6.4	5.1	6.2	6.0	6.0	5.6	7.2	6.4	5.7	7.1	6.4	>5.5	5.8	5.3
Protoconch whorls	1.8	2.0	2.0	2.0	1.8	2.0	1.8	2.0	1.8	1.8	1.8	1.9	2.0	1.9	1.9	1.9	1.9	1.8	2.0	1.9	1.8		2.5	2.6
Spiral cords body whorl	21	>18	22	24	25	22	22	21	22	24	23	21	24	21	23	22	22	20	22	22	23	22	22	23
Spiral cords pen-ultimate whorl	7	7	8	8	9	8	9	7	8	8	8	7	8	7	7	8	9	8	8	9	9	9	7	9
Axial ribs body whorl	10	10	10	10	12	11	10	11	11	11	11	10	11	11	10	10	12	11	10	11	10	13	9	11
Axial ribs pen-ultimate whorl	9	9	9	9	10	10	9	10	9	9	10	9	10	10	9	9	11	10	9	10	9	11	8	9
Denticles outer lip	6	6	7	--	5	6	6	6	5	6	7	7	7	7	6	7	--	6	7	5	--	7	7	7
Denticles inner lip	7	5	4	--	6	7	8	7	4	7	8	6	8	7	6	6	--	7	7	8	--	4	4	4
Notes	a	b		c													d				d	e		

Notes: a) holotype; other specimens of *L. totopotens* are paratypes in order, 1–20; b) shell damaged (repaired by animal), siphonal canal unusually short; c) juvenile, terminal structures of aperture not developed, d) subadult, apertural denticles not formed; e) shell worn, protoconch and part of teleoconch missing.